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Regional differences in thunderstorm intensity driven by monsoon and westerlies over the Tibetan Plateau

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Thunderstorms are weak but frequent, and exhibit unique charge structures over the Tibetan Plateau (TP) where the average elevation is higher than 4 km. In this study, all detected thunderstorms over the TP between 1998 and 2013 by TRMM were divided into four intensity categories: weak, median, severe and extreme. This classification was based on the 75%, 90%, and 99% values of flash rate, maximum 40 dBZ height, minimum 85 GHz polarization-corrected temperature (PCT), and minimum 37 GHz PCT, respectively. The monthly distributions of thunderstorm intensity show that all categories mostly occur in summer over most regions of the TP, and in spring near the Himalayas. Although the peaks of thunderstorms occur during 1300-1600 LT, the thunderstorms occurring in the early morning and evening have a high probability of developing into severe and extreme thunderstorms. This is distinct from the thunderstorms over the Sichuan Basin, the surrounding areas, and the middle and lower reaches of the Yangtze River at the same latitude. On the basis of westerlies- and monsoon-dominated regions, as well as the altitude, the TP was divided into four regions: the eastern, northern, southern and western regions of the TP (namely ETP, NTP, STP and WTP, respectively). The ETP and STP are primarily influenced by the monsoon, with the ETP at a lower altitude than the STP. Conversely, the WTP and NTP are affected by the westerlies, with the WTP situated at a higher altitude than the NTP. Thunderstorms over the ETP are more likely to be severe and extreme than those over the NTP. The percentage of weak thunderstorms is highest over the WTP. It is found that the maximum top height, development depth, horizontal development area, and development volume at 20 dBZ, 30 dBZ, and 40 dBZ echoes are largest over the ETP, followed by the NTP and STP, while being smallest over the WTP. The results imply that thunderstorms influenced by the monsoon are larger and more likely to be severe and extreme than those influenced by the westerlies.